



PS2 Learning Center

Introduction to Radar



SIEMENS



Radar: Level Measurement – Why?

Non-Contacting

- Easy installation from top
- Low maintenance
- No re-calibration
- Low cost of ownership

Generally unaffected by atmospheres with:

Vapor



Extreme
Temperature



Pressure



Dust



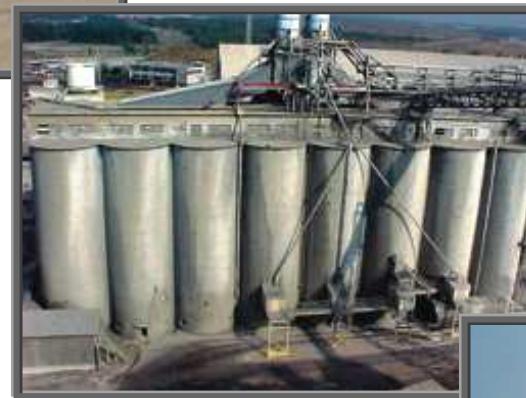


Radar: Industries

Hydrocarbon Processing



MAC



Chemical



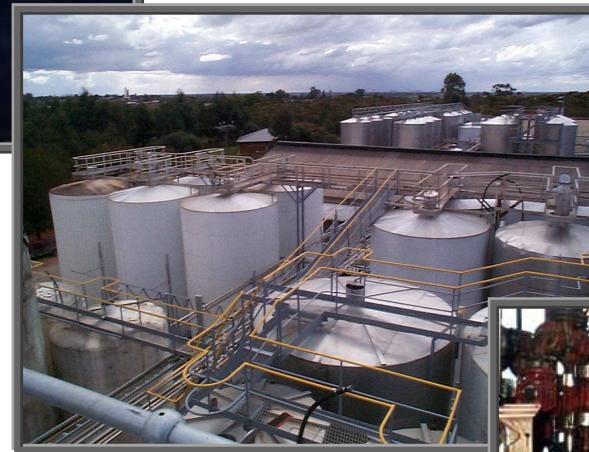


Radar: Applications

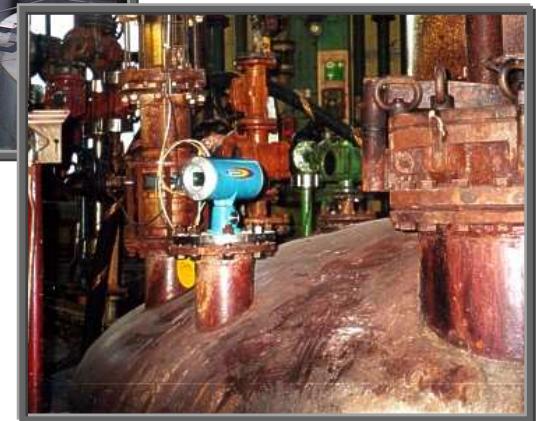
Custody Transfer



Storage



Process





Radar: Types

FMCW

First commercial level
measurement radar



Pulse

First cost effective level
measurement radar





Reliable Level Measurement

Level Transmitters :
Choose the right technology for your
application!





Radar Level Measurement

SITRANS® Probe LR (Economical Version)

- 2-wire loop-powered radar level transmitter for level and volume monitoring of liquids and slurries
- Unaffected by vapors, vacuum, pressure, dust, or extreme temperature
- Range up to 20 m
- High signal-to-noise ratio
- Hermetically Sealed Polypropylene Rod antenna
- Polycarbonate Enclosure
- Sonic Intelligence®
- Auto False-Echo Suppression
- SIMATIC® PDM for remote configuration and diagnostics
- Intrinsically Safe



SIMATIC is a registered trademark of Siemens AG.
SIMATIC PDM is a registered trademark of Siemens Analytics Process Instruments Inc.



Radar Level Measurement

SITRANS LR 200 (Intrinsically Safe Version)

- 2-wire loop-powered pulse radar transmitter for liquid bulk storage or simple process vessels
- Patented, shielded and hermetically sealed polypropylene antenna/ process connection 100 mm 4") shield standard
- Auto False Echo Suppression and Sonic Intelligence
- 20 m (66 ft)
- 5.8 GHz (USA 6.36 GHz)
- Aluminum Enclosure
- Choice of Antenna (Rod/Horn)
- Choice of Process connections
- HART®, SIMATIC PDM or PROFIBUS PA





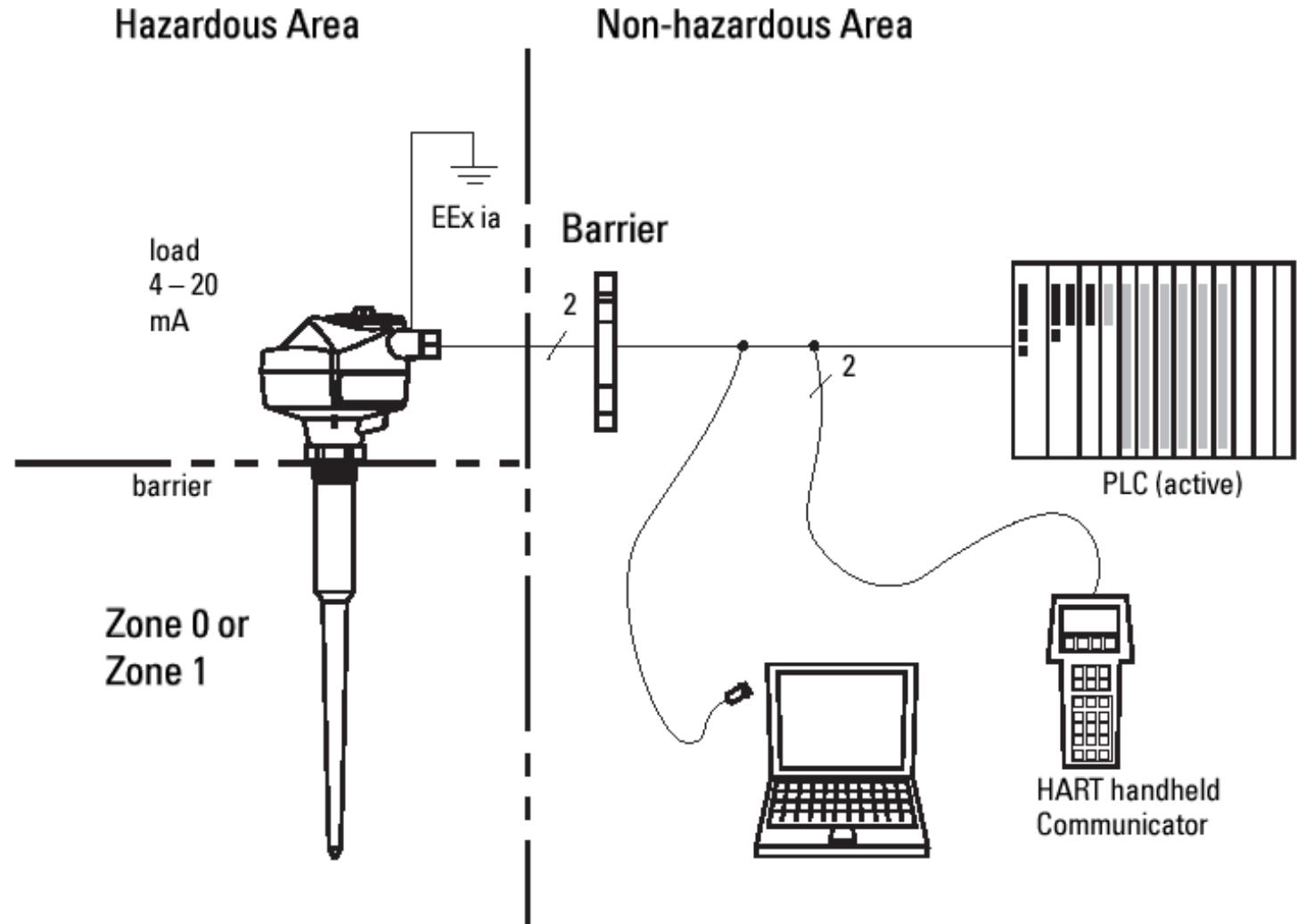
Divisions per NEC 500

Typical of North America

- LR 200 has CSA/FM
intrinsically safe for Class I, II, and III, Div. 1, Groups A-G
 - Class I Liquids and Vapours
 - Class II Dusts
 - Class III Fibres
 - Division 1 Continuous hazard and intermittent hazard
 - Division 2 Hazard present during abnormal functioning
 - Groups (examples of materials):
 - A Acetylene
 - B Hydrogen
 - C Ethylene
 - D Propane
 - E Metal dust
 - F Coal dust
 - G Grain dust



SITRANS LR 200 Intrinsically Safe Installations





SITRANS LR250 – New!!

Introduction

Product definition
and Specs

Market / Theory

SITRANS LR Family

Technology
Selection

Features & Benefits

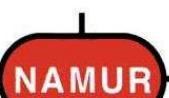
Installation

Application
Experience

Competition

Sales Tools

SIEMENS

- 25GHz Pulse 2-wire loop powered radar
- Continuous level measurement
 - Non Contacting Technology
 - Liquids and slurries
 - No influence from vapor, temperature, pressure
- Process Intelligence
 - Quick Start Wizard for easy set up
 - Extremely reliable echo processing
- Wide range of applica 
 - Simple Bulk storage to process control
- Target Markets
 - Chemical, Petrochemical





Radar Level Measurement

SITRANS LR 300 (High Energy Version)

- 3 Wire Pulse radar transmitter for extreme process conditions
- Measures liquids and slurries in process vessels
- 28 Meter (66 ft)
- 5.8 GHz (USA 6.36 GHz)
- Auto False Echo Suppression
- **Stainless steel** enclosure or sanitary available
- Modbus[®], ASCII/RTU, HART or PROFIBUS PA (option)
- Use in Hazardous Area

Modbus is a registered trademark of Schneider Electric.





Sitrans LR uses Intrinsically Safe device Handheld programmer

- Intrinsically Safe
- No need to open enclosure like competitor devices
- No need to connect wires or plug in modules for local programming
- Easy set up – 2 parameters
- Multi-Graphical display





SITRANS LR Series

Process Intelligence Signal Processing

Introduction

Features & Benefits

Installation

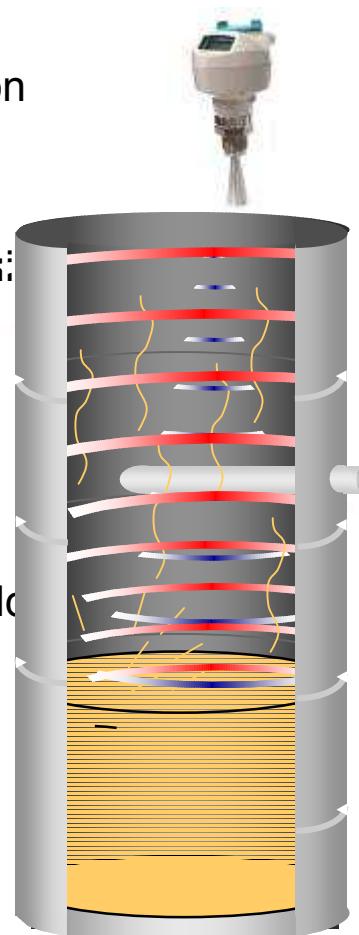
Process Intelligence

Field Proven

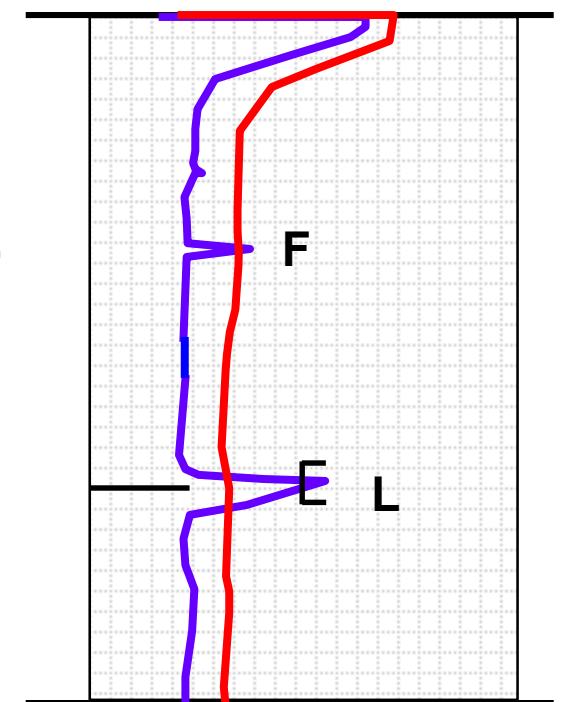
Conclusion

SIEMENS

- Quick Start Wizard
 - Plug & play performance
- Based on over 1 million applications
- bLF algorithms for liquid
- Auto False-Echo
- Suppression
- Dynamic TVT thresholds
 - Condensation OK!
 - Variable process OK!
 - Changing dK OK!
- CLEF algorithm
 - Low level accuracy
 - at tank bottom area for



Process Intelligence





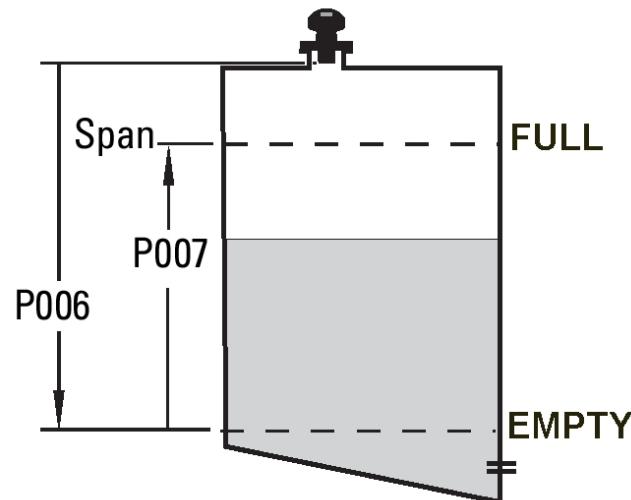
Features & Benefits

Easy to Use

Easy set-up using as few as 2 parameters

Rotating head design

- Allows for easy wiring
- Re-position after installation to view display





SITRANS LR250

Field Proven

Waste solvents



Alkali resin



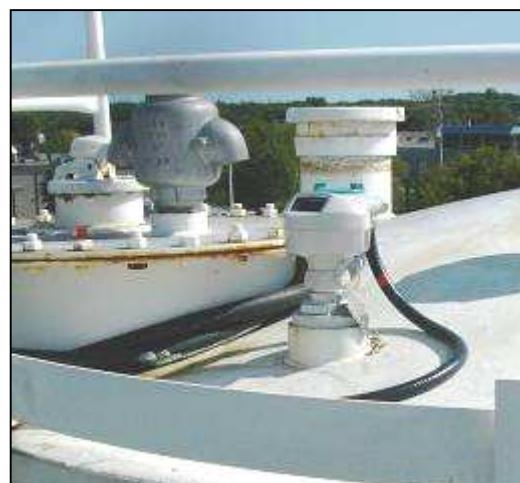
Polyether liquid



Hot water with steam
& condensation



Petrol



NaMo liquid

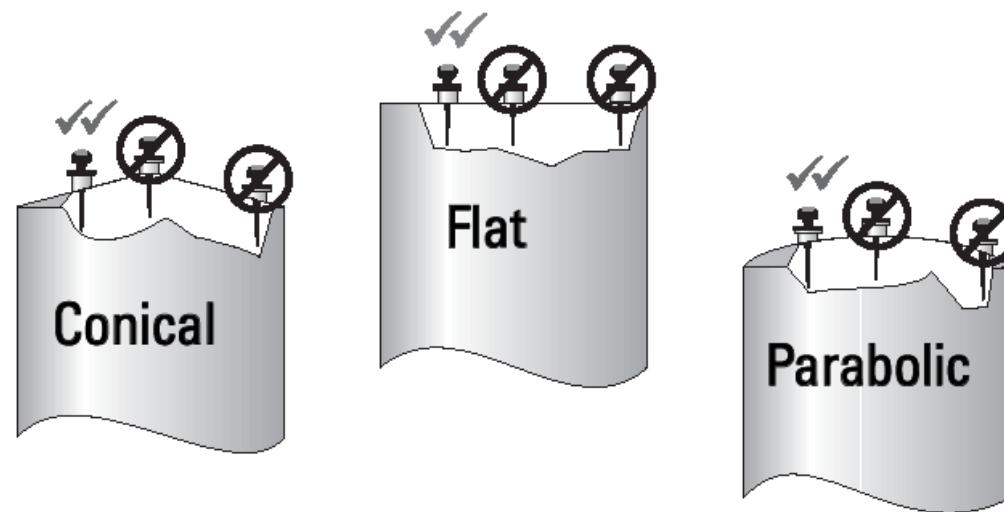




SITRANS LR Applications: Mounting Locations

If you can choose:

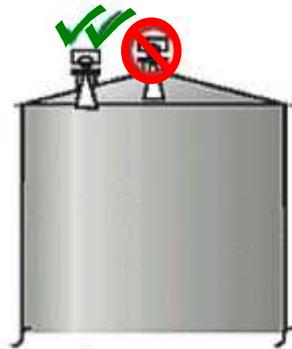
- Largest diameter/shortest height nozzle
- Furthest from off-axis obstructions
- 10:1 depth to wall ratio or more (LR 200 and LR 300)
- 20:1 ratio for LR 400



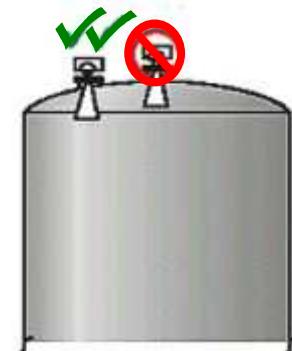


SITRANS LR Applications: Mounting Locations

Conical



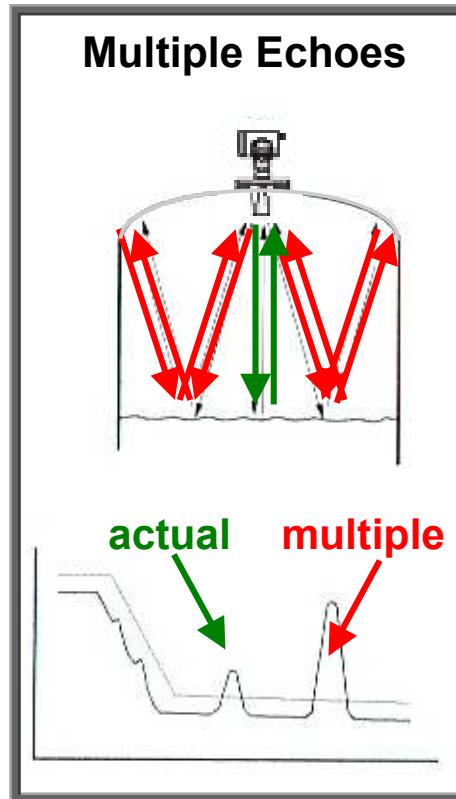
Parabolic



Flat

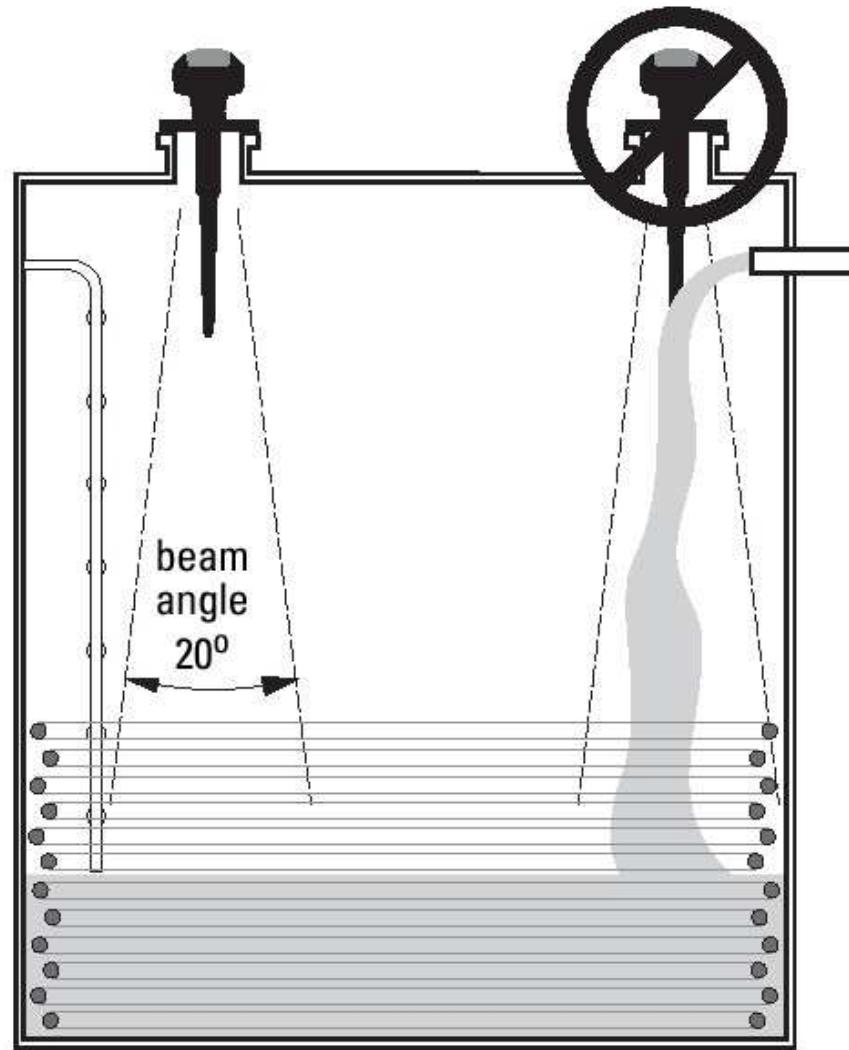


Fill Path





SITRANS LR Applications: Mounting Locations – Vessel Obstructions

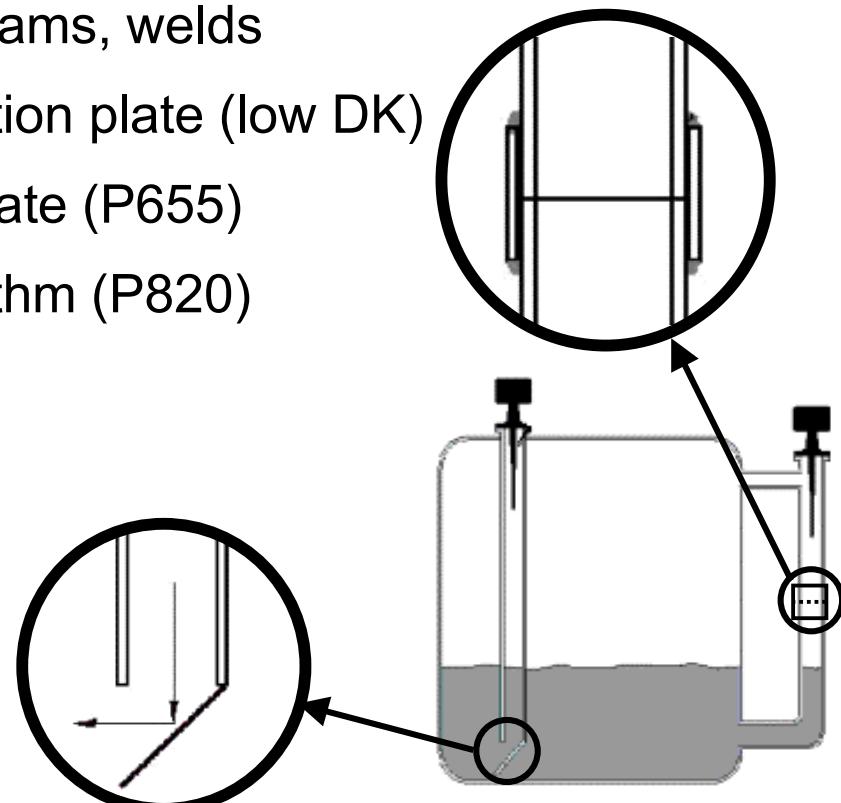




SITRANS LR 200 and LR 300: Mounting Locations – Stillpipes and Sidepipes

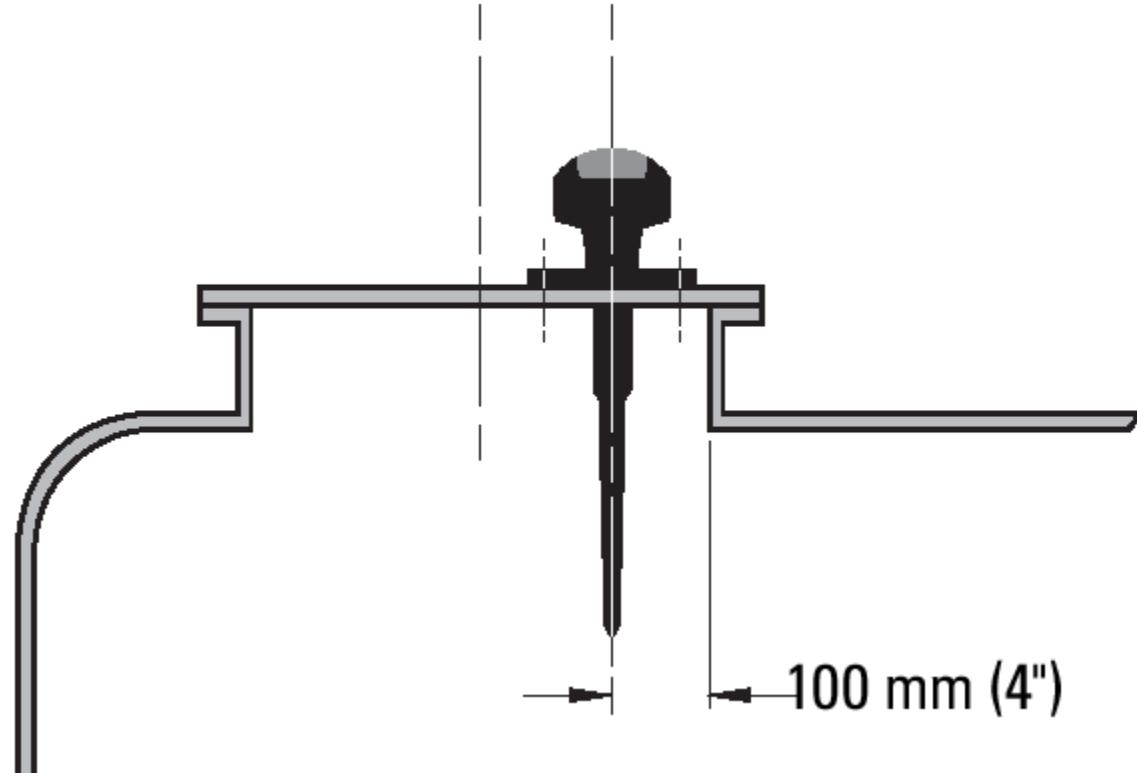
Stillpipe or sidepipe mounting:

- 2" (50 mm) to 10" (250 mm) diameters
- Clean, free flowing liquids only
- No internal burrs, seams, welds
- Use pipe end deflection plate (low DK)
- Adjust propagation rate (P655)
- Use first echo algorithm (P820)





SITRANS LR Applications: Mounting Locations – Man-Way Covers



Do not mount in the center

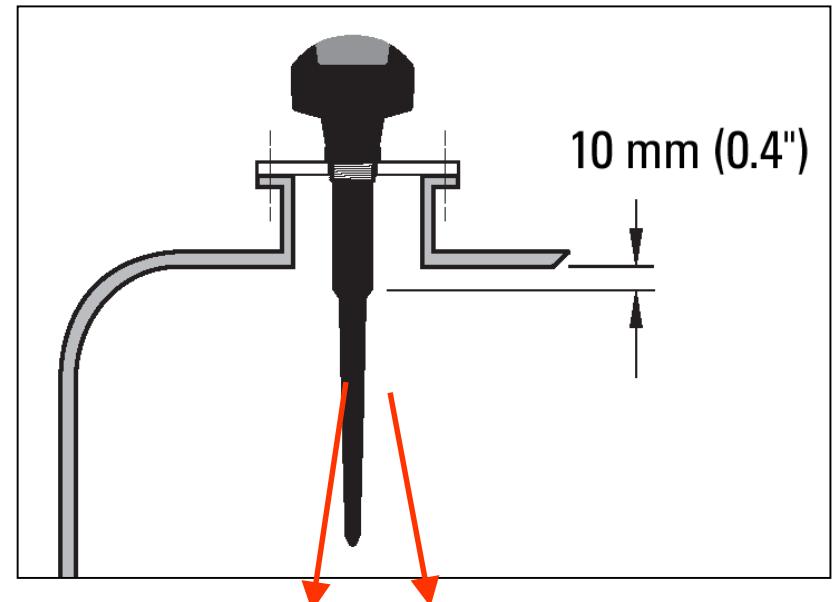


SITRANS LR 200: Uni-Construction Antenna



- 100 mm (4") long shielded
or
- 250 mm (10) long shield

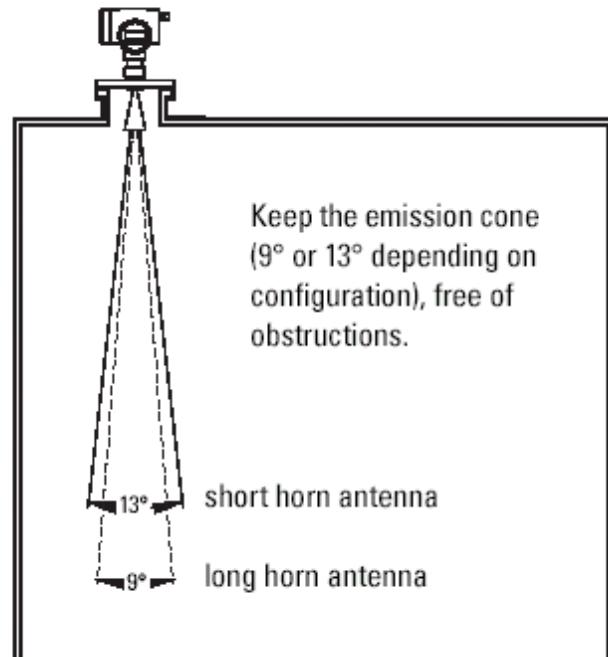
- 1-1/2" NPT, or G, or BSP
- Ensure that the nozzle is not longer than the shield length or erratic readings will result



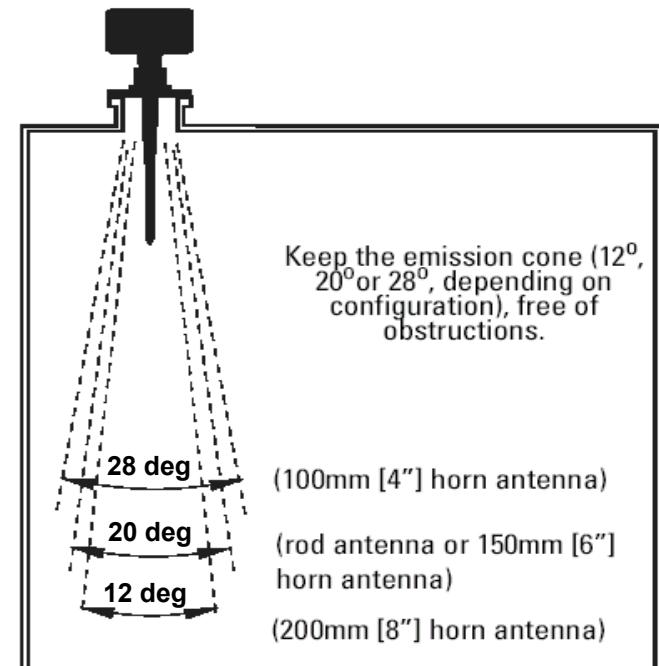


SITRANS LR: Antenna Selection – Beam Spreading

SITRANS LR 400
24 GHz



LR 200 and LR 300
5.8/6.3 GHz





SITRANS LR 200 and LR 300: Process Connection/Antenna Selection Modularity

Uni-construction
Rod Version



OR

Flange Adapter
Version





SITRANS LR 200

Uni-construction
Rod Version

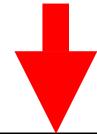


SIEMENS



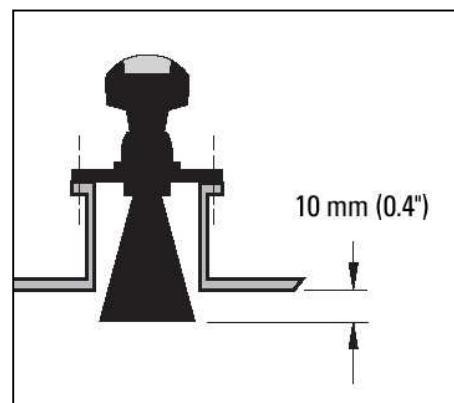
SITRANS LR 200

Flange Adapter Version





LR 200 and LR 300: Antenna Selection – Horns



Horn antenna:

- Sizes available:
 - 75, 100, 150, 200 mm (3, 4, 6, 8")
 - 200 mm (8") is the best performer*
- Purging possibilities
- Higher level without material contact
- Less susceptible to deposits
- User replaceable gasket
- The antenna of choice when there are no size limitations or chemical compatibility issues



LR 200 and LR 300 Antenna Selection: Horn with Waveguide Extension

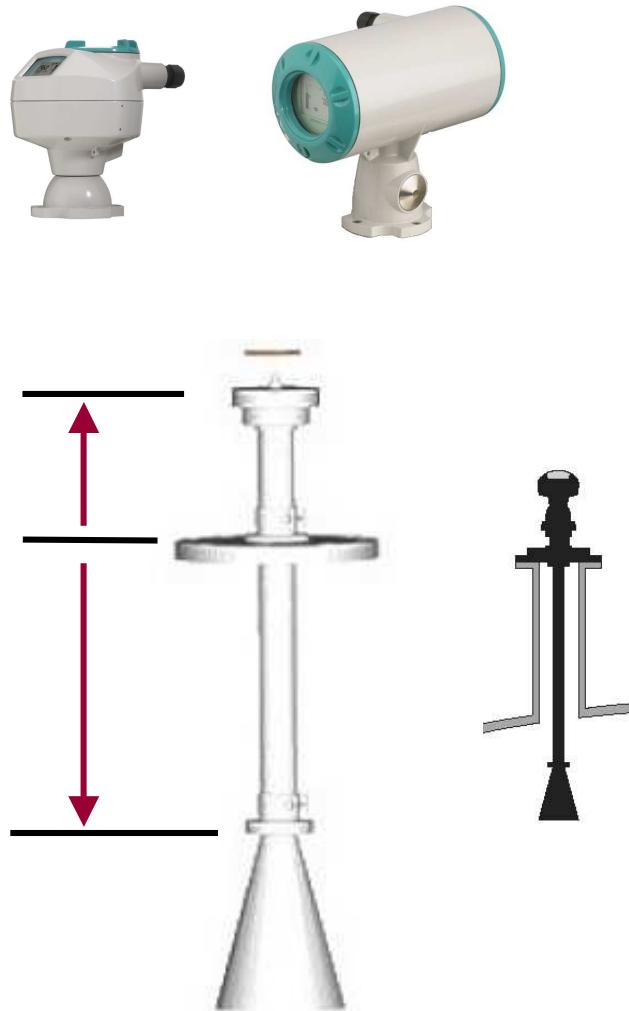


Enables horn use despite:

- Long nozzles
- Thick roof (e.g. 24" concrete)
- Tank obstructions
- High temperature isolation
- Curved waveguides
(by Configuration Center)



LR 200 and LR 300: Antenna Selection – Horn with Waveguide and Sliding Flange Extension



For anaerobic digesters:

- Horn retracts through valve to prevent gas escape during service
- No CO₂ or Methane release
- Easy and safe inspection/service



Antenna Selection: Waveguide



All the benefits of a stillpipe:

- Stronger echoes from low dielectric constant materials
- Internal tank obstruction avoidance
- Surface stilling and foam isolation
- Recommended for materials with dielectric constants between 1.5 and 3.0
- Low turbulence
- Limited suspended solids
- Maximum 3.0 m (10 ft)



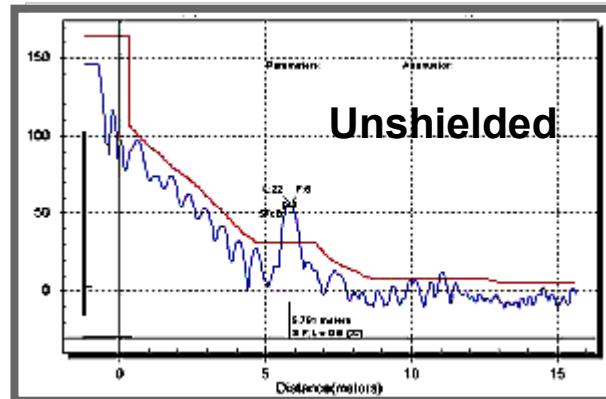
Antenna Selection: Shielded Rod (Stainless Steel)



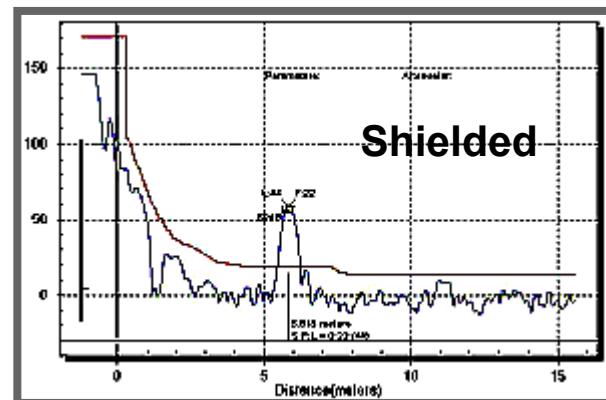
- Eliminates nozzle interference
- Higher pressure rating than polypropylene rod
- Higher temperature rating than polypropylene rod
- Available in 2" thread mount only
- Select standard length to suit
- Watch chemical compatibility
 - Shield section is 316 stainless steel
 - Internal Viton O ring between PTFE rod and shield section



LR 200 and LR 300: Unshielded versus Shielded Rod

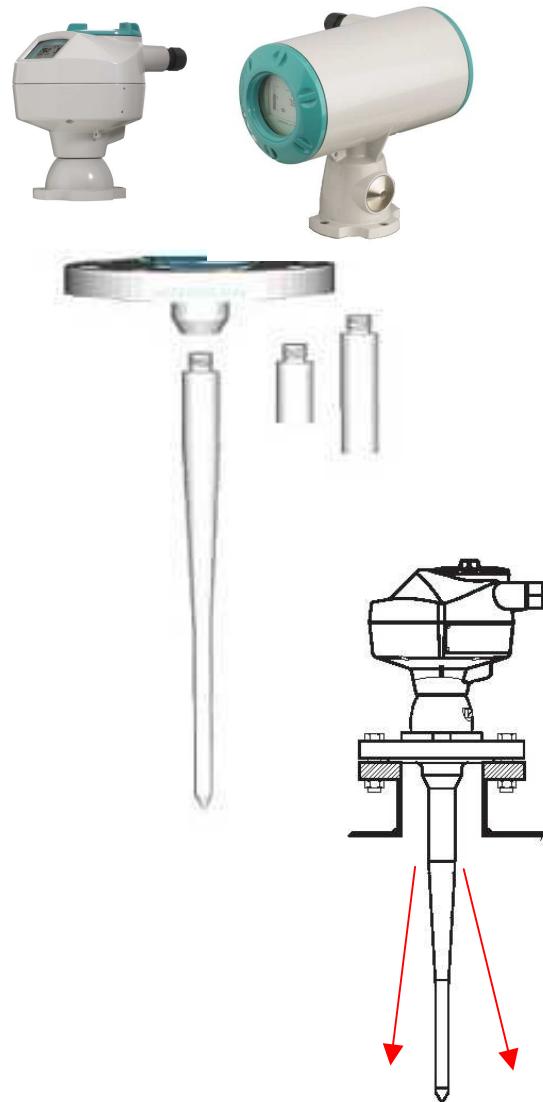


- Note the “ringing” effect
- Instrument will have difficulty reading higher levels
- False low level readings are common as instrument selects multiple echo instead of first





Antenna Selection: Flange c/w PTFE Rod



- PTFE for high chemical resistance
- PTFE for higher temperature ranges
- All wetted parts PTFE
- Use Loctite 592 (provided) to seal threads from moisture ingress
- 50 mm (2") or 100 mm (4") antenna extension can be used for longer nozzles. See instruction manual for details.



Antenna Selection: Sanitary Rod



Clean-in-place
spray ball

For Food and Beverage and
Pharmaceutical markets.

- 2", 3", and 4" tri-clamp versions
- One-piece antenna design with integral gasket
- UHMW-PE (low cost) material or PTFE





SITRANS LR Applications: Special Considerations

Some things to remember about:

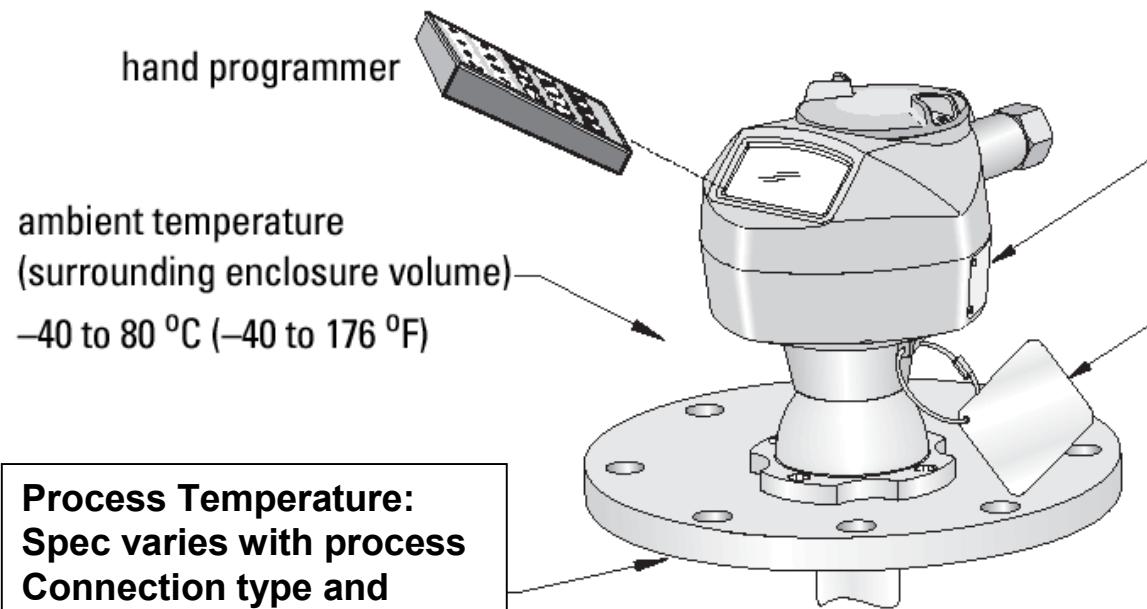
- Temperature and pressure limits
- Antenna deposits
- Foam
- Low dielectric materials





SITRANS LR Applications: Special Consideration – Temperature/Pressure

Temperature and Pressure limits are inter-related
and antenna/process connection dependent!



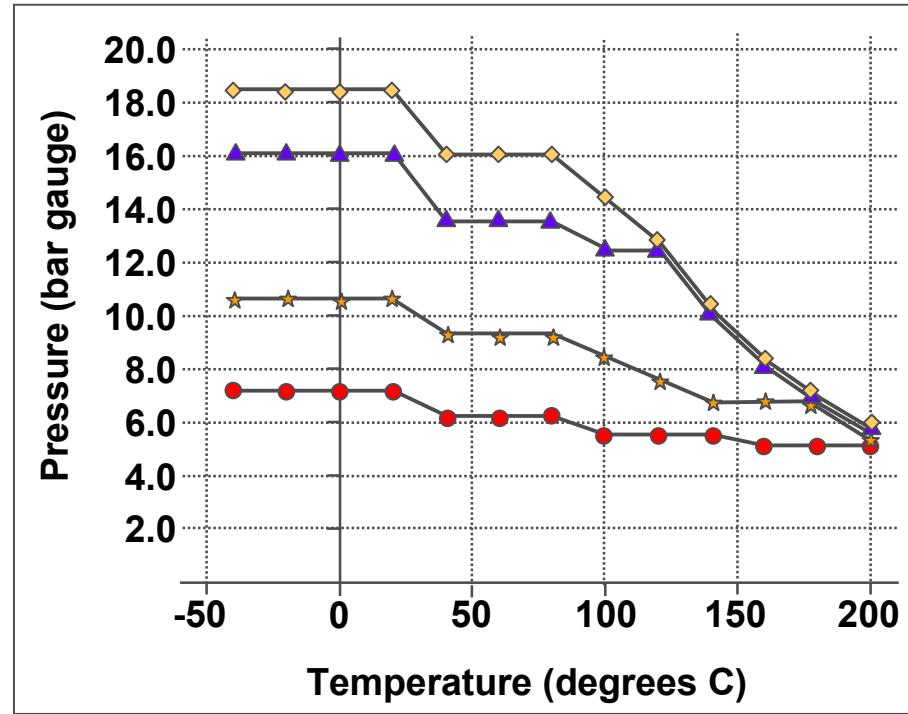
Process Temperature:
Spec varies with process
Connection type and
Antenna used!
Check instruction manual
or spec sheets for
specification curves.

**Up to 200°C possible
Up to 40 Bar possible**



SITRANS LR Applications: Special Consideration – Temperature/Pressure

Pressure Curve example:
**Each process connection and
antenna system has its own curve.**





SITRANS LR Applications: Special Consideration – Antenna Deposits

- Water condensation is OK
- Some attenuate signals
 - Low DK deposits OK
 - High DK deposits usually a problem
- A horn antenna is less susceptible than a rod antenna
- A horn antenna purging system may be used in extreme cases
- 24 GHz radar is more sensitive to antenna deposit than 6 GHz radar

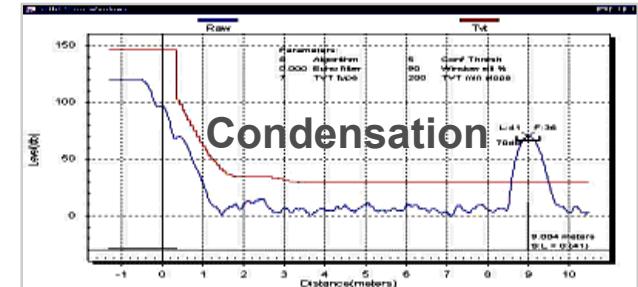
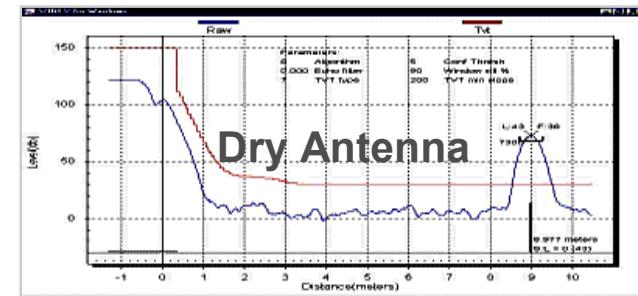


Extreme Case!



SITRANS LR 200 and LR 300 Applications: Antenna Deposit – Condensation

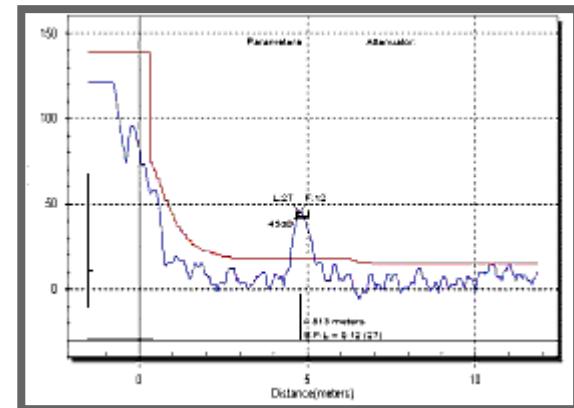
- 6 GHz is less sensitive to heavy condensation than 24 GHz





SITRANS LR Applications: Antenna Deposit – Low DK Material

- 24 GHz radar is more sensitive to antenna deposit than 6 GHz radar





SITRANS LR Applications: Antenna Deposit – High DK Material

Application:

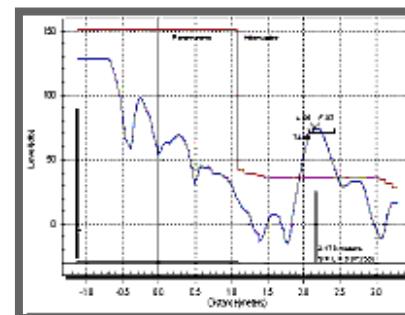
- Chemical plant reactor
(Titanium Dioxide slurry)

Material Characteristics:

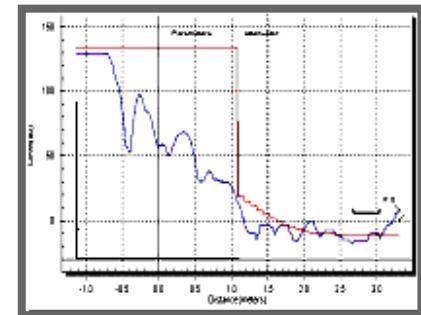
- Wet slurry
- High dielectric constant

Performance:

- Echo signal lost
- Customer installed
water cleaning
nozzles



Clean Antenna



With Build-Up

(No echo)



SITRANS LR Applications: Special Consideration – Foam

- 6 GHz radar has slightly better foam penetration than 24 GHz radar





SITRANS LR Applications: Dry Foam

Application:

- Malting Process (beer)

Foam Characteristics:

- 5 g/litre (0.3 lb/ft³)
- Up to 2 m (6.6') deep

Performance:

- Ultrasonic transducer
 - Frequent LOE
- Radar
 - Tracked material surface through foam layer 90% of the time





SITRANS LR Applications: Wet Foam

Application:

- Paper mill (floatation cell)

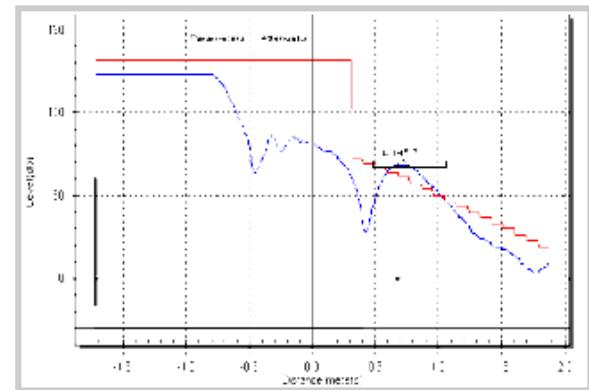
Foam Characteristics:

- 65 g/litre (0.3 lb/ft³)
- On aerated slurry



Performance:

- Detected foam surface
- Tracked level reliably
- **24 GHz and 6 GHz radar both reflect from wet foam surfaces**





SITRANS LR Applications: Medium Foam

Application:

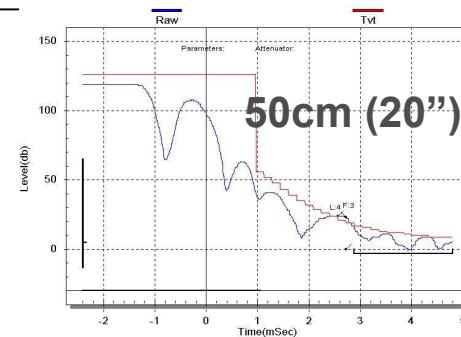
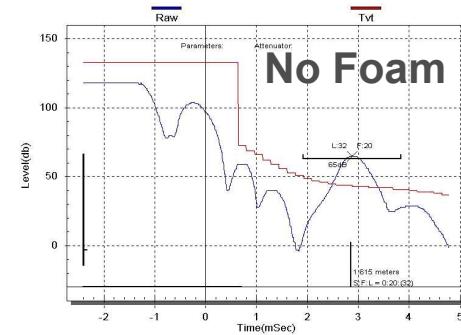
- Chemical Plant (wastewater)

Foam Characteristics:

- Varying density and depth

Performance:

- **Not suitable for RADAR**





SITRANS LR

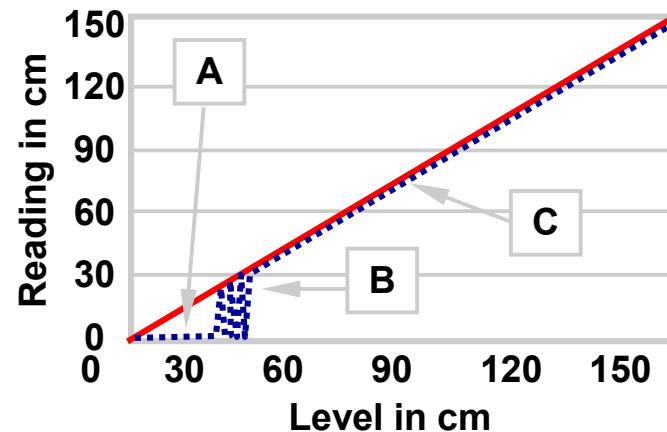
Special Consideration – Low Dielectric Constant

For materials with $\text{DK} < 3$:

- Use a stillpipe/waveguide to boost signal strength
- Bottom 40 cm (1.3') of tank may not be measurable
- Use first echo algorithm to avoid bottom detection
- Use a bottom deflection plate if necessary

Fill Trend
Low DK Material

- Radar level
- Actual level
- A - Tank bottom detected
- B - Area of instability
- C - Tracking level

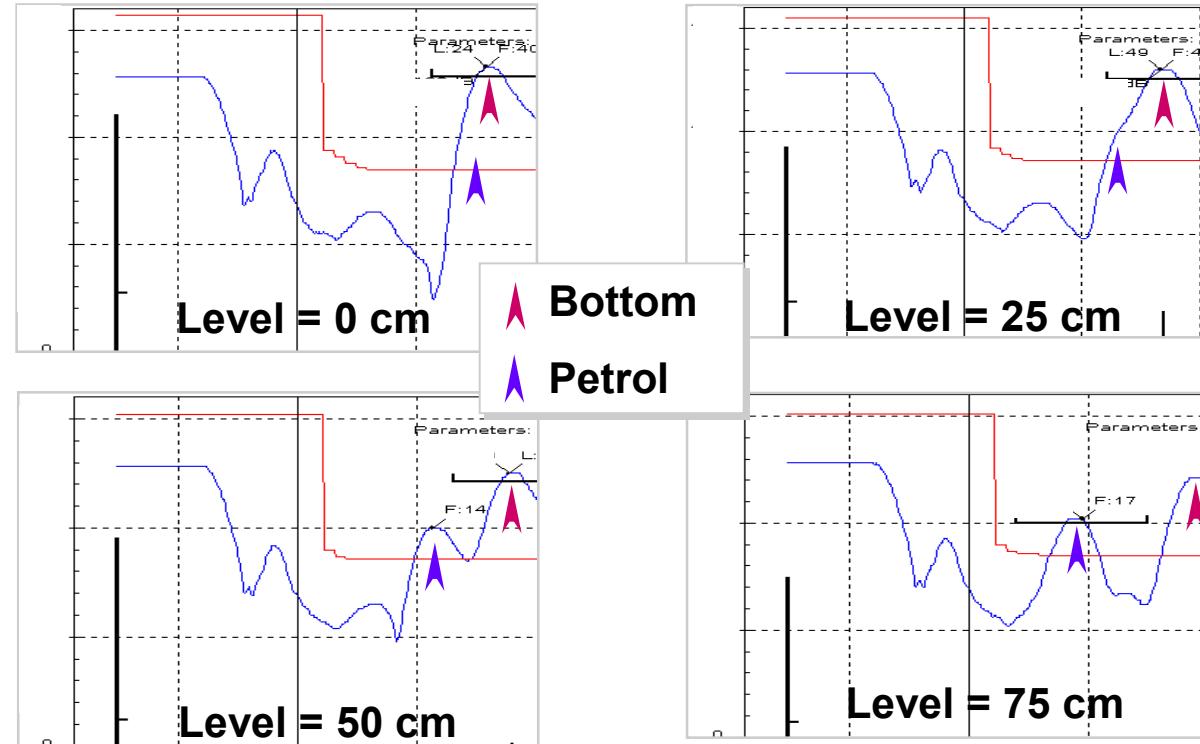




SITRANS LR: Microwave Propagation through Petrol

Conditions:

- 6 GHz Radar on stillpipe
- Echo profiles taken at various petrol levels





Diagnostics,
Status information

Measurement with deposit & encrustation Process optimization with instrumentation technologies

Application:

Titanium dioxide production, measurement on sticky titanium dioxide process reactor.

Process requirement:

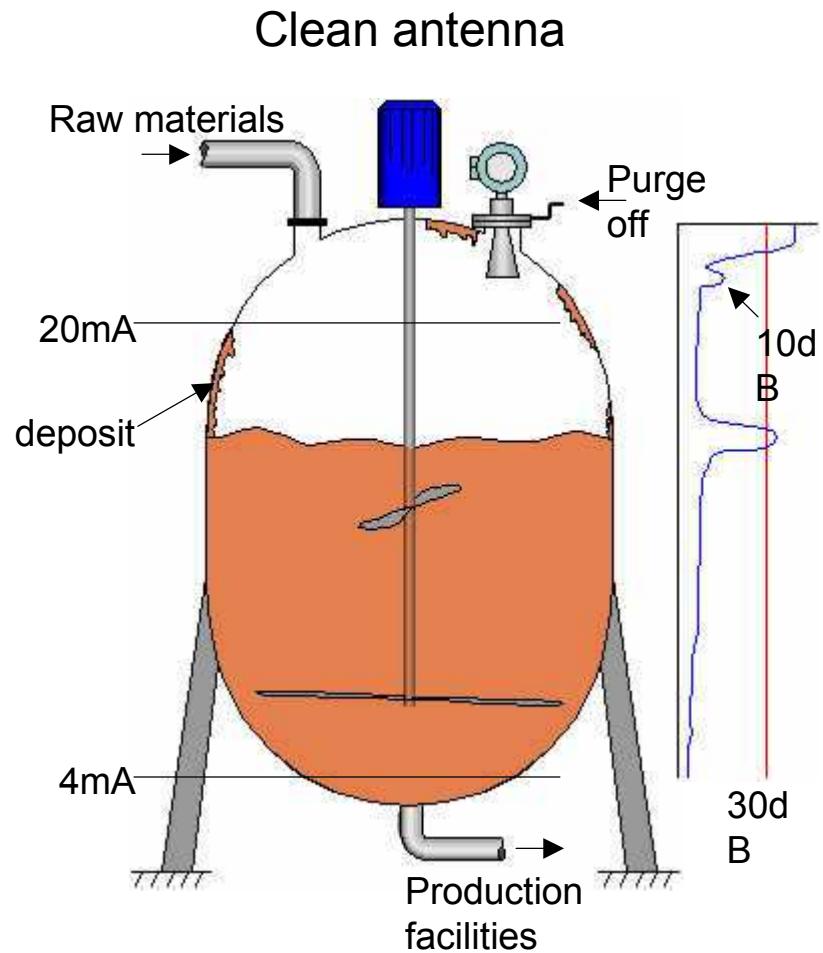
Reliable and maintenance free level and volume measurement with self cleaning capabilities.

Technologies:

Radar level instrumentation.

Solution:

Comparing internal antenna echoes and activating an integrated purge process for cleaning purposes by diagnostic and status information from the level instrument.





Measurement with deposit & encrustation





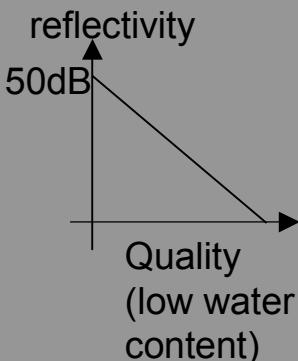
Measurement with deposit & encrustation





Diagnostics,
Status information

Reflectivity vs.
product quality



SIEMENS

Measurement with deposit & encrustation Process optimization with instrumentation technologies

Application:

Paraffin production in the
chemical and petrochemical
industries

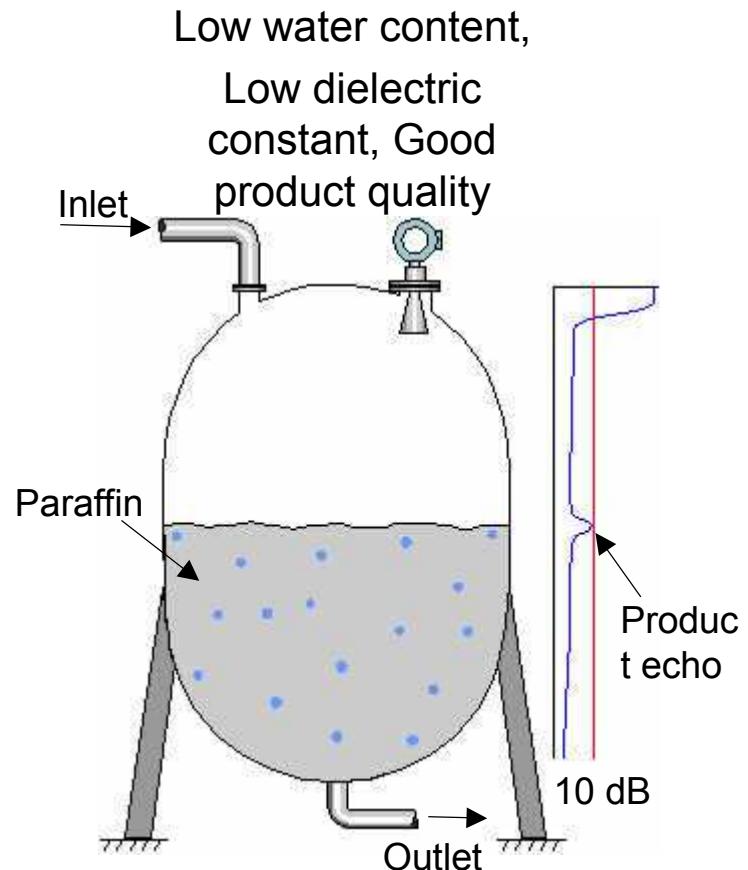
Process requirement:

Volume measurement and
water content detection in
order to improve product
quality & overfill protection

Level technologies: Radar / capacitance

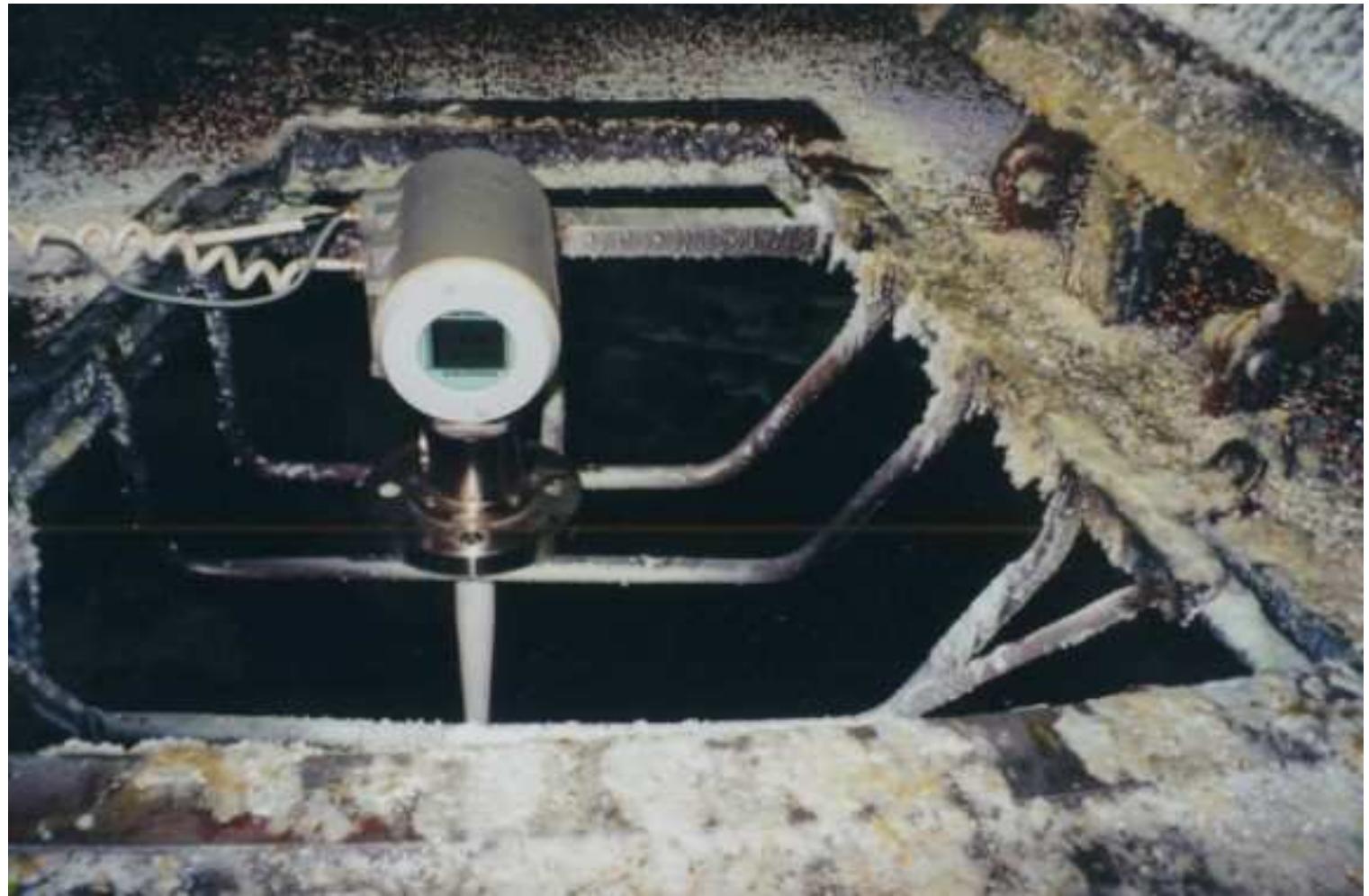
Solution:

The level sensor is measuring
the volume inside the tank. In
addition the reflectivity of the
product is detected in order to
evaluate the dielectric





Measurement with deposit & encrustation





Tank Management/Tank Monitoring

**Level Measurement with
Sitrans LR300 on crude oil,
white oil and floating roof.**

**Tanks using 2“ stillpipes
(length 14,5m)**

**Substitution of mechanical
servo gauge systems.**

(Germany)





Tank Management/Tank Monitoring

Substitution of servo gauge system with Sitrans LR300 and waveguide arrangement



Level Measurement with Sitrans LR300 on crude oil, white oil and floating roof tanks using 2“ still pipes (length 14,5m). Substitution of mechanical servo gauge systems.





Tank Management/Tank Monitoring

Special 12“ horn antenna on 12“ Still pipe





Tank Management/Tank Monitoring

Sitrans LR300 with 2“ still pipe on white oil





Tank Management/Tank Monitoring

Tank inventory on low DK

Resign products with

- Sitrans LR300/400
- Sitrans LC 300
- Sitrans LC 500

